REMARKS/ARGUMENTS

By this Amendment, claims 1, 28, and 31-35 have been amended have been amended for clarity. Claims 43-46 have been added. Accordingly, claims 1-46 are pending in the present application.

The Examiner states that the information referred to in Applicant's information disclosure statement (IDS) filed on December 6, 1999 has not been considered on the basis that the statement does not include a concise explanation of relevance. Enclosed are copies of English language abstracts for each of the references listed on the IDS in compliance with 37 CFR 1.98(a)(3), along with a revised copy of the PTO-1449 for the convenience of the Examiner. Consideration of the information respectfully is requested.

Also enclosed is a new IDS with attached information and an English translation of Reasons for Refusal issued in the corresponding Japanese application.

The Examiner objects to the abstract of the disclosure. A revised abstract is attached, as required.

The Examiner objects to the specification on the basis of informalities. The Examiner's concern with regard to page 5, line 19 is not understood by Applicant, and clarification is requested. The specification has been revised as required to correct the typographical error on page 30, line 19.

The Examiner objects to claim 1 on the basis of an informality. Claim 1 has been corrected as required.

Claims 1, 2, 5, 10, 19, and 31 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Pat. No. 6,292,582 to Lin et al. Claims 20-22, 28-30, and 32-34 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin et al. Claims 3, 4, 7-9, 16, and 35-40 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin et al. in view of U.S. Pat. No. 5,093,869 to Alves et al. Claims 11-15 stand rejected

under 35 U.S.C. § 103(a) as being unpatentable over Lin et al. in view of U.S. Pat. No. 5,898,440 to Tachibana. Claims 17, 18, 24, and 25 stand rejected under 35 U.S.C. Lin et al. in view of U.S. Pat. No. 5,929,557 to King et al. Claims 23, 26, 27, and 41 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin et al. in view of Alves et al, further in view of King et al. Claim 42 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin et al. in view of Alves et al, further in view of U.S. Pat. No. 5,898,440 to Tachibana. Claim 6 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin et al. in view of U.S. Pat. No. 6,427,030 to Williams et al. Applicant respectfully traverses all prior art rejections.

The present invention as recited in amended claim 1 is an image processing apparatus including "gradient calculation means for calculating at least the direction of the level gradient of a processing unit in a given image data including a plurality of pixels, the pixels respectively having level data." In addition, the apparatus includes "line segment formation means for producing line segment image data representing a line segment having a given length and a direction corresponding to the direction of the level gradient which is calculated by said gradient calculation means." The apparatus also includes "line segment image storage means for storing the line segment image data produced by said line segment formation means."

In contrast to the present invention as recited in amended claim 1, Lin et al. discloses a method and system for identifying defects in a semiconductor which uses a decomposition window to trace an image. The decomposition window 98 may consist of sections 99 (Fig. 6) that are used to compare pixels within different sections of deposition window 98 to determine the gradient for window 98. The decomposition window 98 senses the gradient of a line 106 and begins tracing in the direction of segment 106. Each pixel considered along segment 106 is processed, while searching for a change in gradient which may signal a new line segment or the end of the line segment. (column 10, lines 7-11, lines 30-34) (emphasis added). Lin et al. does not teach or suggest an image processing apparatus including "gradient calculation means for calculating at least the

direction of the level gradient of a processing unit in a given image data including a plurality of pixels, the pixels respectively having level data" as recited in claim 1 of the present invention. Lin et al. also does not disclose or suggest "line segment formation means for producing line segment image data representing a line segment having a given length and a direction corresponding to the direction of the level gradient which is calculated by said gradient calculation means," also recited in claim 1. Further, since Lin et al. does not produce line segment image data as recited in claim 1, the reference does not teach or suggest an apparatus that has "line segment image storage means for storing the line segment image data produced by said line segment formation means." Thus, Lin et al. does not anticipate the present invention recited in amended claim 1.

In paragraph 6 of the Office action, the Examiner asserts that Lin et al. discloses a line segment formation means at col. 12, lines 41-42, and suggests that the line segment has a direction corresponding to the direction of the level gradient. Applicant respectfully disagrees. In contrast to the present invention, the line segment formation means disclosed in Lin et al. is used to remove discontinuities in the image trace. In the tracing method of Lin et al., discontinuities are produced by a lack of gradient data, resulting in no line segment connecting between two points. Discontinuities are removed simply by connecting two nearby points. Thus, contrary to the Examiner's assertion, Lin et al. does not teach or suggest "line segment formation means for producing line segment image data representing a line segment having a predetermined length and a direction corresponding to the direction of the level gradient which is calculated by said gradient calculation means," as recited in amended claim 1.

The present invention as recited in amended claim 28 is an image processing apparatus including "an image processing means for calculating at least the direction of the level gradient of a processing unit in given image data, and producing line segment data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient." In addition, the apparatus includes a "display means for displaying a line

segment image represented by the line segment image data produced by said image processing means."

As noted above in connection with claim 1, Lin et al. does not teach or suggest an image processing means for "producing line segment data representing a line segment having a predetermined length and a direction corresponding to a direction of the level gradient for each image data having a non-zero level gradient." As a result, Lin et al. also does not teach or suggest "display means for displaying a line segment image represented by the line segment image data produced by said image processing means." Thus, independent claim 28 is submitted as being patentable over the cited Lin et al. reference.

The present invention as recited in amended claim 31 is an image processing method including the steps of "calculating at least the direction of the level gradient of a processing unit in given image data including a plurality of pixels, the pixels respectively having level data." The method also includes steps of "producing line segment image data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level gradient." In addition, the method includes "storing the produced line segment image data in storage means."

As noted above in connection with claims 1 and 28, Lin et al. does not teach or suggest producing line segment image data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level gradient. Accordingly, Lin et al. also does not teach or suggest storing the produced line segment image data in storage means. Claim 31 is submitted as being patentable over Lin et al.

The present invention as recited in amended claim 32 is a medium storing a program for controlling a computer so as to "calculate at least the direction of the level gradient of a processing unit in given image data including a plurality of pixels, the pixels

respectively having level data." In addition, the program will control the computer to "produce line segment image data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level gradient." The program also will cause the computer to "store the produced line segment image data in storage means."

As noted above, Lin et al. does not teach or suggest an apparatus or method intended to "produce line segment image data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level gradient." Consequently, Lin et al. does not teach or suggest a program that also will cause the computer to "store the produced line segment image data in storage means." Thus, Lin et al. does not anticipate or render obvious the present invention as recited in amended claim 32.

The present invention as recited in amended claim 33 is an image processing method that includes "calculating at least the direction of the level gradient of a processing unit in given image data." The method also includes "producing line segment image data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient." In addition, the method has steps for "displaying a line segment image represented by the produced line segment image data on a display device."

As noted above, Lin et al. does not teach or suggest a process for producing line segment image data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient. Thus, Lin et al. does not teach or suggest a method having steps for displaying a line segment image represented by the produced line segment image data on a display device. Accordingly, Lin et al. does not anticipate or render obvious the present invention as recited in amended claim 33.

The present invention as recited in amended claim 34 is a medium storing a program for controlling a computer so as to "calculate at least the direction of the level gradient of a processing unit in given image data, and produce line segment image data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each processing unit having a non-zero level gradient." In addition the program controls the computer to "display a line segment image represented by the produced line segment image data on a display device."

As noted above, Lin et al. does not teach or suggest a method or apparatus that will produce line segment image data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each processing unit having a non-zero level gradient. Consequently, Lin et al. does not teach or suggest a program that controls the computer to display a line segment image represented by the produced line segment image data on a display device. Thus, Lin et al. does not anticipate or render obvious the present invention as recited in amended claim 34.

The present invention as recited in claim 35 is an image processing apparatus which includes "means for extracting a plurality of edges whose level gradients are not less than a predetermined value in given image data," and "means for setting, for each of the edges, a line segment extending a predetermined length in a direction corresponding to the direction of the extracted edge." The image processing apparatus also includes "means for detecting the presence or absence of a point of intersection of a plurality of line segments and the position thereof."

In contrast to the present invention as recited in amended claim 35, Lin et al. does not teach or suggest means for setting, for each of the edges, a line segment extending a predetermined length in a direction corresponding to the direction of the extracted edge. On the contrary, Lin et al. merely traces the outline of the image. Thus, Lin et al. also does not teach or suggest an image processing apparatus that includes "means for detecting the

presence or absence of a point of intersection of a plurality of line segments and the position thereof."

The present invention as recited in claim 37 an inspection apparatus which includes an "image input means for inputting image data representing an inspection object." The inspection apparatus also includes "means for calculating at least the direction of the level gradient of a processing unit in said input image data, and producing line segment image data representing a line segment having a direction corresponding to the calculated direction of the level gradient." In addition, the inspection apparatus includes "means for detecting the presence or absence of a portion where line segment images are concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data."

In contrast to the present invention as recited in claim 37, Lin et al. does not teach or suggest means for calculating at least the direction of the level gradient of a processing unit in said input image data, and producing line segment image data representing a line segment having a direction corresponding to the calculated direction of the level gradient. On the contrary, as noted above, Lin et al. traces an image outline. In addition, since the reference does not teach or suggest producing the line segment image data, Lin et al. also does not disclose or suggest an inspection apparatus that includes "means for detecting the presence or absence of a portion where line segment images are concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data."

Alves et al. does not cure the deficiencies of Lin et al. Alves et al. also discloses a tracing, or boundary formation, process (column 5, line 38-39). According to the disclosure of Alves et al., boundary formation takes, followed by linear feature extraction. Alves et al. does not teach or suggest calculating a direction of the level gradient of a processing unit in said input image data, and producing line segment image data representing a line segment having a direction corresponding to the calculated direction of

the level gradient.

The remaining references to Tachibana, King et al., and Williams et al., do not cure the deficiencies of Lin et al. Tachibana, King et al., and Williams et al. have not been asserted against any independent claims, only against dependent claims.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned **"Version with markings to show changes made."**

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

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Respectfully submitted,

By _____

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Version With Markings to Show Changes Made

In the Specification:

Replacement for paragraph, 3, page 30:

For example, a local region (3 pixels by pixels) is set for a pixel g at a coordinate position (x, y), as shown in Fig. 7. In differential processing by the [Sober] Sobel method, level gradients dx (x, y) and dy (x, y) along the respective axes are respectively calculated by equations (1) and (2) using a luminance (brightness) level I of each of the pixels:

$$dx(x, y) = \{I(x+1, y-1) + 2 \cdot I(x+1, y) + I(x+1, y+1)\} - \{I(x-1, y-1) + 2 \cdot I(x-1, y) + I(x-1, yx1)\}$$

In the Claims:

1. (Amended) An image processing apparatus comprising:

gradient calculation means for calculating at least the direction of the level gradient of a processing unit in a given image data including a plurality of pixels, the pixels respectively having level data;

line segment formation means for producing line segment image data representing a line segment having a given length and a direction corresponding to the direction of the level gradient which is calculated by said gradient calculation means [and a given length]; and

line segment image storage means for storing the line segment image data produced by said line segment formation means.

28. (Amended) An image processing apparatus comprising:

an image processing means for calculating at least the direction of the level gradient of a processing unit in given image data, and producing line segment data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient; and

display means for displaying a line segment image represented by the line segment image data produced by said image processing means.

31. (Amended) An image processing method comprising the steps of:

calculating at least the direction of the level gradient of a processing unit in given image data including a plurality of pixels, the pixels respectively having level data;

producing line segment image data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient [and a given length] for each pixel having a non-zero level gradient; and

storing the produced line segment image data in storage means.

32. (Amended) A medium storing a program for controlling a computer so as to:

calculate at least the direction of the level gradient of a processing unit in given image data including a plurality of pixels, the pixels respectively having level data;

produce line segment image data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient [and a given length] for each pixel having a non-zero level gradient; and

store the produced line segment image data in storage means.

33. (Amended) An image processing method comprising:

calculating at least the direction of the level gradient of a processing unit in given image data, and

producing line segment image data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient; and

displaying a line segment image represented by the produced line segment image data on a display device.

34. (Amended) A medium storing a program for controlling a computer so as to:

calculate at least the direction of the level gradient of a processing unit in given image data, and produce line segment image data representing a line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each processing unit having a non-zero level gradient; and

display a line segment image represented by the produced line segment image data on a display device.

35. (Amended) An image processing apparatus comprising:

means for extracting a plurality of edges whose level gradients are not less than a predetermined value in given image data;

means for setting, for each of the edges, a line segment extending a predetermined length in a direction corresponding to the direction of the extracted edge; and

means for detecting the presence or absence of a point of intersection of a plurality of line segments and the position thereof.

Replacement Abstract:

See attached page.

ABSTRACT OF THE DISCLOSURE

In a gray level image, the direction and the magnitude of a level gradient are found for each of pixels. With respect to the pixel having a level gradient whose magnitude exceeds a predetermined value, a line segment having a predetermined length is drawn in the direction of the level gradient from the pixel or a position spaced apart from the pixel by a predetermined distance. The luminance level of the line segment corresponds to the magnitude of the level gradient. A portion where a lot of line segments are overlapped with one another or a portion where the line segments are concentrated is detected, to recognize the center, the corners, etc. of an object appearing on the image.